

# Model 407A

## *CW Laser Power Meter*



## User's Manual


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# Model 407A

## CW Laser Power Meter

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# EU Declaration of Conformity

We declare that the accompanying product, identified with the  mark, complies with requirements of the Electromagnetic Compatibility Directive, 2004/108/EC and the Low Voltage Directive 2006/95/EC.

**Model Number: 407A**

**Year  mark affixed: 1995**

**Type of Equipment:** Electrical equipment for measurement, control and laboratory use in industrial locations.

**Manufacturer:** Newport Corporation  
1791 Deere Avenue  
Irvine, CA 92606

## **Standards Applied:**

Compliance was demonstrated to the following standards to the extent applicable:

EN 50081-2:1993 Emissions:

EN 55011 Class A Radiated

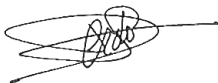
EN 55011 Class A Conducted

EN 50082-1:1992 Immunity:

IEC801-2 Electrostatic Discharge

IEC 801-3 RF Radiated

IEC 801-4 Fast Transient



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## Warranty

Newport Corporation warrants that this product will be free from defects in material and workmanship and will comply with Newport's published specifications at the time of sale for a period of one year from date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's option.

To exercise this warranty, write or call your local Newport office or representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the product, freight prepaid, to the indicated service facility. Repairs will be made and the instrument returned freight prepaid. Repaired products are warranted for the remainder of the original warranty period or 90 days, whichever first occurs.

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Newport Corporation  
1791 Deere Avenue  
Irvine, CA, 92606, USA  
Part No. H0407-1030, Rev. K

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## **Service Information**

This section contains information regarding factory service for the source. The user should not attempt any maintenance or service of the system or optional equipment beyond the procedures outlined in this manual. Any problem that cannot be resolved should be referred to Newport Corporation.

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# Safety Precautions

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## Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the Model 407A CW Laser Power Meter where safety-related issues occur.

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## General Warning or Caution



*Figure 1 - General Warning or Caution Symbol*

The Exclamation Symbol in the figure above appears on the product and in Warning and Caution tables throughout this document. This symbol designates that documentation needs to be consulted to determine the nature of a potential hazard, and any actions that have to be taken.

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## Electric Shock



*Figure 2 – Electrical Shock Symbol*

The Electrical Shock Symbol in the figure above appears throughout this manual. This symbol indicates a hazard arising from dangerous voltage. Any mishandling could result in irreparable damage to the equipment, and personal injury or death.



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## European Union CE Mark



*Figure 3 – CE Mark*

The presence of the CE Mark on Newport Corporation equipment means that this instrument has been designed, tested and certified compliant to all applicable European Union (CE) regulations and recommendations.

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## Alternating voltage symbol



*Figure 4 – Alternating Voltage Symbol*

This international symbol implies an alternating voltage or current.

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## Waste Electrical and Electronic Equipment (WEEE)



*Figure – WEEE Directive Symbol*

This symbol on the product or on its packaging indicates that this product must not be disposed with regular waste. Instead, it is the user responsibility to dispose of waste equipment according to the local laws. The separate collection and recycling of the waste equipment at

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the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For information about where the user can drop off the waste equipment for recycling, please contact your local Newport Corporation representative.

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## Warnings and Cautions

The following are definitions of the Warnings, Cautions and Notes that are used throughout this manual to call your attention to important information regarding your safety, the safety and preservation of your equipment or an important tip.



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### WARNING

**Situation has the potential to cause bodily harm or death.**

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### CAUTION

**Situation has the potential to cause damage to property or equipment.**

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### NOTE

**Additional information the user or operator should consider.**

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## General Warnings

- Observe these general warnings when operating or servicing this equipment:
- Heed all warnings on the unit and in the operating instructions.

- 
- Do not use this equipment in or near water.
  - Route power cords and other cables so that they are not likely to be damaged.
  - Disconnect power before cleaning the equipment. Do not use liquid or aerosol cleaners; use only a damp lint-free cloth.
  - To avoid explosion, do not operate this equipment in an explosive atmosphere.
  - Qualified service personnel should perform safety checks after any service.

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## General Cautions

- Observe these cautions when operating this equipment:
  - If this equipment is used in a manner not specified in this manual, the protection provided by this equipment may be impaired.
  - Do not position this product in such a manner that would make it difficult to disconnect the power cord.
  - Use only the specified replacement parts.
  - Follow precautions for static sensitive devices when handling this equipment.
  - This product should only be powered as described in the manual.
  - Adhere to good laser safety practices when using this equipment.
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## Summary of Warnings and Cautions

The following general warning and cautions are applicable to this instrument:



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### WARNING

**Before operating the Model 407A CS Laser Power Meter, please read and understand all of Section 2.**

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### WARNING



**Do not attempt to operate this equipment if there is evidence of shipping damage or you suspect the unit is damaged.**

**Damaged equipment may present additional hazards to you. Contact Newport technical support for advice before attempting to plug in and operate damaged equipment.**

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### CAUTION



**The user is advised to save the packaging material in case the unit has to be shipped to a different location. The packaging material is specially designed to protect the unit during shipping.**

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### WARNING



**To avoid electric shock, and potential damage to the instrument, use only the detachable power supply provided with your instrument. Do not substitute third-party power supplies.**

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### WARNING



**To avoid electric shock, and potential damage to the instrument, be sure the detachable power supply is appropriate for use with the available MAINS power. If your instrument's power supply is marked for use with nominal 110 VAC power, do not connect it to 220/240 VAC power.**

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### **Theory of Operation**

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The detection and measurement of laser power can be classified under two headings, photon detection and thermal detection. Photon detection such as silicon photocells directly converts the energy of individual photons into a voltage or a current, depending on internal construction. The present discussion will focus on thermal detectors since the Model 407A uses one type of thermal detector.

Thermal detectors have the common property that they convert light into heat and then convert the heat into a useable electric signal. Light is converted to heat through absorption of the incident radiation at the front surface of the detector. The degree to which the radiation is absorbed will depend on the spectral absorptance of any coating applied.

A perfectly absorbing surface is one which absorbs 100% of incident radiance for all wavelengths; this is known as a blackbody. Surfaces which uniformly absorb radiation of all wavelengths, but which absorb less than 100%, are known as “greybodies”. In reality surfaces are generally “colored bodies” since they reflect some radiation, and the fraction reflected is a function of wavelength. All thermal detectors have this feature. Good detector coatings maximize the absorptance and minimize the variation of absorptance with wavelength.

The type of thermal detector used in the Model 407A is known as a thermopile. A thermopile is essentially an organized collection of thermocouple junctions connected electrically in series. A thermocouple consists of a junction of two dissimilar metals. This dissimilar metal junction has the property that a temperature-dependent electrical potential difference is developed across the junction due to the difference in the electronic solid state properties of the component metals. This is known as the Seebeck effect.

A useful detector is made by isolating a reference junction from temperature change, and then measuring the voltage difference between the reference and the signal junctions as the signal junction temperature is varied, with the two junctions wired in series.

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## Features of the Model 407A

The Model 407A Power Meter features a redesigned thermopile detector that withstands 20 KW/cm<sup>2</sup> average power density. The result is a robust detector suitable for the high average power density generated by modern ion lasers. The Model 407A detector is capable of measuring power from a few milliwatts up to >20 Watts. The cw detector head has been tested at up to 30 W with no significant loss of linearity. In the 20 to 30 W range, the primary limitation on performance is case temperature. However, care should be taken not to focus high power laser beams on the detector. For further discussion, see Chapter 4, “Limitations on Use of Thermal Detectors.”

While the Model 407A is designed to measure cw laser power average power output of some pulsed lasers can be measured. High peak powers can damage the detector, so care must be taken when considering use of the Model 407A in this application. Refer to Chapter 4, “Operation,” for more information.



The meter and head are quite compact and robust. Thus the Model 407A can be transported easily – it will even fit in a briefcase. And it can fit into tight places.

The Analog meter is illuminated by two lamps whenever the charger is plugged in, allowing you to work in dark conditions.

Detector Absorbance as a Function of Wavelength

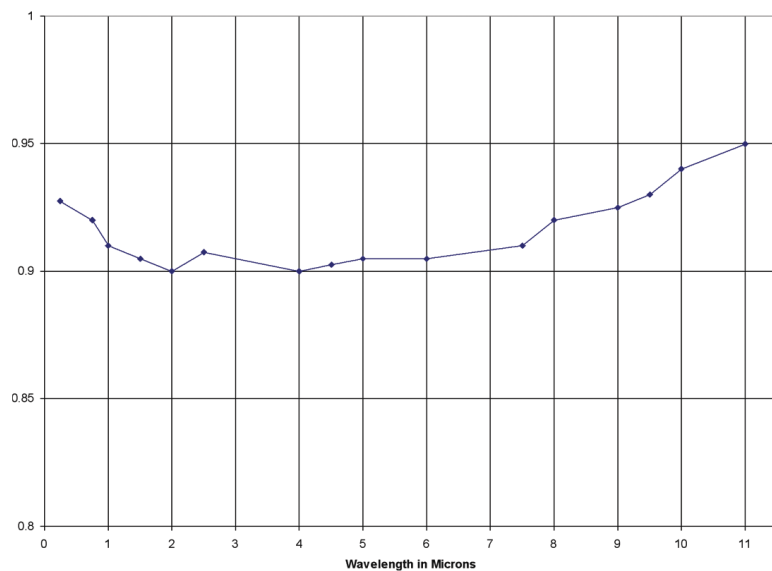


Figure 1-1

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# Model 407A Specifications

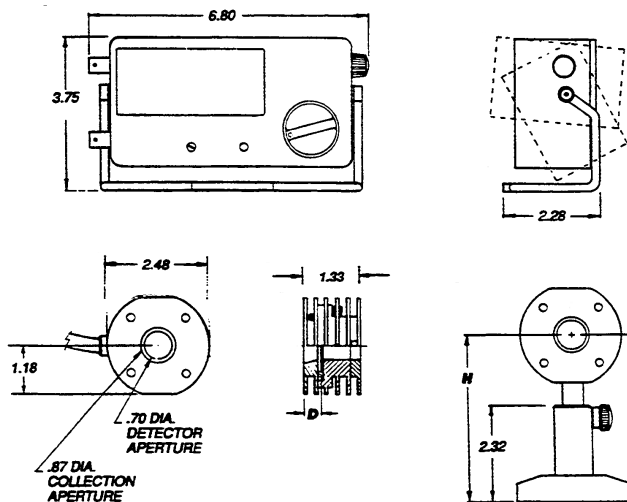
## Physical Specifications

Specification	
<b>Wavelength Range</b>	250 nm to 11 $\mu$ m
<b>Power Range</b>	
Continuous	<5 mW to 20W
Intermittent	Up to 30 W
<b>Max Power Density</b>	20 KW/cm <sup>2</sup>
<b>Detector Diameter</b>	1.8 cm
<b>Sensitivity Variation</b>	
400 - 100 $\mu$ m	$\pm 1\%$
250nm – 11 $\mu$ m	$\pm 3\%$
<b>Calibration Accuracy</b>	
For 1 W @ 810 nm	$\pm 1\%$
<b>Detector Spatial Sensitivity Variation</b>	
(using a 2mm beam)	$\pm 2.5\%$
<b>Maximum pk-pk Noise &amp; Zero Drift per Minute</b>	
1 W scale	<0.2% full scale
30 mW scale	<2% full scale
<b>Meter Time Constant</b>	
1 W scale or higher	<0.5 sec
30 mW scale	< 1 sec
<b>Meter Ranges</b>	30 mW, 100 mW, 300mW, 1W, 3W, 10W, 30W
<b>Battery Charge</b>	60 hr (minimum)
<b>Electrical Requirements</b>	
Model 407A-1	90-132 Vac, 50-60 Hz
Model 407A-2	198-264 Vac, 50 Hz



Physical Dimensions	Display	Detector Head
Width	17.5 cm (6.8 in.)	6.3 cm. Dia. (2.5 in.)
Height	9.5 cm ( 3.75 in.)	Adjustable from 8.9 to 21.1 cm (3.5 to 8.3 in.) (to center of detector)
Length	5.8 cm (2.28 in.)	3.4 cm (1.3 in.)
Weight	0.6 kg (1.4 lbs.)	0.3 kg (0.7 lbs.)

## Outline Drawings



Distance to Detector Surface (D)	
Non-Pulsed	0.42
Pulsed	0.37

Height (H)		
Post	Min	Max
Short	3.5	5.3
Medium	5	6.8
Tall	6.5	8.3

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**CAUTION**

**While the Model 407A does not emit laser radiation, it is designed to work with Class IV High Power Lasers, whose beams are, by definition, safety and fire hazards. Take precautions to prevent accidental exposure to both direct and reflected beams. Diffuse as well as spectacular reflections, can cause severe eye or skin damage.**

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**Precautions for the Safe Operation of Class IV High Power Lasers**

- Keep the chassis housing and covers on the laser and the Model 407A at all times.
- Avoid looking at the laser output beam; even diffuse reflections, for example off the detector surface, are hazardous.
- Use protective eyewear at all times; selection depends on the wavelength, and the visual function required. Consult the ANSI, ACGIH, or OSHA standards listed at the end of this section for guidance on eye wear selection.
- Reduce the laser output power while aligning the Model 407A to the beam. Beware of reflections from the Model 407A heat sink.
- Avoid blocking the laser output beam or its reflection with any part of the body.
- Establish a controlled access area for laser operation. Limit access to those trained in the principles of laser safety.
- Post prominent warning signs near the laser operation area.
- Set up experiments so that the laser beam is not at eye level.
- Provide enclosures for beam paths whenever possible.
- Set up shields to prevent or block unnecessary specular reflections.
- Set up an energy absorbing target to capture the laser beam, preventing unnecessary reflections or scattering.

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For information on regulations for laser safety, consult the United States code of Federal Regulations: Title 21, Chapter 1, Subchapter J, Parts and 1040.10 and 1040.11 as applicable. The Center for Devices and Radiological Health (CDRH) is the governing regulatory agency.

### **Sources of Laser Safety Standards**

“Safe Use of Lasers” (Z1236.1)

American National Standards Institute (ANSI)

1430 Broadway

New York, NY 10018

“A Guide for Control of Laser Hazards”

American Conference of Governmental and Industrial Hygienists

(ACGIH)

1014 Broadway

Cincinnati, OH 45202

Occupational Safety and Health Administration (OSHA)

U.S. Department of Labor

400 1st Street N. W.

Washington, C.C. 20001

**Unpacking Your Power Meter**

When ordered as a complete set, the Model 407A comes with the following components:

- Readout Assembly  
Readout  
Cable, BNC, 5 foot length  
Power Supply/Charger, 117 Vac or 220 Vac
- Detector Head Assembly  
Detector Head  
Detector Base  
Detector Posts, 1/4 - 20 tapped, 1/2 inch O.D., 2", 4", and 6"
- Instruction Manual
- Shipping and Storage Container

If readout assembly or head assembly is ordered separately, it will be shipped in a standard shipping container.

**Assembly**

The Model 407A comes with a power supply in one of two standard voltages. During use the power supply should be powered with proper ac voltages and plugged into the Model 407A readout in order to fully charge the rechargeable battery. Normal recharge time for the battery is 14-16 hours. Once the battery charger/power supply is plugged in, the Model 407A panel lights will be energized. The lights will stay lit as long as the unit is plugged in. If the light must be off or if portable operation is desired, the Model 407A can be operated without its charger for up to 60 hours (on a fully charged and healthy battery).

The Model 407A comes to you pre-calibrated at the factory. We use an NIST-traceable standard detector at 810 nm, as a laboratory calibration reference from which all units are calibrated

Select the telescoping 1/2 inch diameter post which is appropriate for your laser set up. Note that the rods are compatible with standard laboratory mounting rods and can be used in combination with any exist-

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ing hardware. Observe that the rod can be threaded onto 1 of 2 different 1/4-20 UNC threaded studs located 180 degrees apart on the detector head. This feature allows the user to conveniently work with beams incident from either the left or right because the cable can be routed to the front or rear as necessary.

If the telescoping rods are too long for a tight space, the head has flats onto it which facilitate placing it directly on any flat surface. The beam height above the flat to the detector centerline is 1.18 inches.

## 4

## Operation

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### Location and Description of Controls

#### Side Panel Controls

REC OUT: A standard BNC type connector can be attached in order to display the output signal on an oscilloscope or a strip chart recorder or can serve as an input to a computer's A/D channel. The output impedance is 10 K $\Omega$ . The range is 0-1 volts with 1 volt representing the full scale value on the analog meter.

CHARGE: A 15 volt direct current power supply is supplied standard with all Model 407A power meters. Two variations are supplied—a 110 volt ac supply for U.S.A., Canada and Japan, and a 220 volt ac for Europe (in U.K., contact your local Spectra Physics office for availability of domestic power supplies). See Chapter 6 for ordering information and part numbers. It is recommended that the supply is left plugged in during normal operation. The Model 407A has been designed to permit indefinite battery charging without damage to batteries or the charging circuit.

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#### NOTE

**If you desire NOT to have the meter illuminated you must unplug the supply. A separate light switch was not supplied in order to avoid inadvertent draining of the battery by using the lights without the charger operating.**

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**HEAD:** The detector head uses a standard BNC type connector which connects to the bottom jack labeled HEAD. Inadvertent cross connecting between the HEAD and RECOUT should be avoided, but should cause no harm to the Model 407A.

**ZERO:** The zero knob is connected to a 10 turn potentiometer. The zero adjust circuit has been carefully designed so that once the meter has adjusted to read zero on the most sensitive scale, the readout will be correctly zeroed for all other scales (the mechanical meter zero, described below, must also be properly adjusted). Re-zeroing as scales are changed is thus unnecessary. Note however, that on the most sensitive scales some drift will occur if the detector is subjected to thermal variations such as air drafts.

## **Front Panel Controls**

**BATT LOW:** If the Model 407A is used without its charger, the BATT LOW light will begin to blink (Approximately once every two seconds) when the battery has drained to the point that it must be recharged. At this time you should plug the charger into a wall outlet and connect the charger plug to the receptacle on the side of the 407A display unit. The 407A may continue to be used while the battery is charging. If the LED has been blinking some time before battery is recharged, the LED may continue to blink for several minutes after the charger is plugged in while battery voltage increases.

A full charge normally requires 14 hours with the 407A's range selector switch in the OFF position, and 16 hours otherwise.

Although a blinking BATT LOW light indicates the need for a recharge, you can safely operate your 407A an additional 20 minutes before connecting the charger. Exceeding this time can have two effects: Loss of accuracy (which will be most noticeable on the lowest range setting) and possible shortening of battery life. Full discharge of the battery should be avoided. Multi-cell nickel-cadmium batteries such as the one provided with your Model 407A are prone to damage from cell reversal, a phenomenon which occurs when such batteries are taken into deep discharge while under load.

**POWER RANGE SELECTOR SWITCH:** The front panel knob has a total of 8 positions, including an OFF position. The meter should always be turned off when not in use in order to avoid battery drain.

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During use always adjust the scale setting starting from higher value scales in order to avoid unnecessary overdriving of the needle to beyond full scale.

**MECHANICAL METER ZERO:** Directly below the meter is a screw which allows the needle to be adjusted to read zero when the meter is off. Normally the adjustment is not necessary but should be checked when the 407A is first uncrated, and occasionally thereafter. This adjustment is prerequisite to proper operation of the side panel zero knob.

## **Rear Panel Controls**

**CALIB:** A 1/8-inch wide screwdriver will permit adjustment of the meter output. Adjustments should only be attempted in conjunction with the instructions given in Chapter 5 of this manual.

**SPEED:** An access hole on the back panel allows the meter speed up circuit to be adjusted to suit individual preference. The potentiometer has been factory adjusted so that the response give maximum settling time and will give needle overshoot of about 1 to 2 percent, when the detector is suddenly exposed to an optical input.

The output signal from the head does not rise instantaneously when the detector is exposed to a laser beam. Due to the mass of the absorbing material to which the thermopile is attached, the output rise in an exponential manner with a time constant (0-63 percent of final value) of about 1 second. Several seconds are required for the output to stabilize at its final value. Treating the output rise as purely exponential, an estimate of final value can be made very quickly by passing the signal through a compensating network in the display which is adjusted to match the detector's time constant. In this way, a final value can be determined and displayed in about one second.

Two drawbacks occur to this speeding up of the output signal. Abrupt changes in the signal applied to the compensating network, which occurs when adjusting the ZERO control and when changing scales, cause the meter response to exhibit overshoot. Also, noise in the circuit is accentuated over that seen without the compensating network.

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## Operating Instructions

The Model 407A was designed for ease of operation. During normal operation only initial zeroing of the meter and power range selection is required.

### Turning on the Model 407A

The Model 407A will arrive with the battery in a partially or completely charged condition. The charging circuit is designed not to damage the battery even during extended charging periods. Therefore we recommend that the user normally leave the power supply plugged into the Model 407A and into an ac power source.

Input signals not derived from the head may cause rapid but momentary needle motion due to the influence of the anticipation circuit. Examples include scale changes and zeroing the meter. This behavior is normal.

### Zeroing Procedure

1. While the meter selection knob is in the OFF position, verify that the meter needle points to zero. If adjustment required, rotate the screw on the front panel of the readout to zero the needle.
2. Plug in the detector head to the readout jack marked HEAD using the BNC cable provided. The head should ideally be placed in the location where actual measurements will be made, but without any optical radiation applied.
3. Rotate the power range knob to the 30mW setting. Adjust the zero position as required using the zero adjust knob on the right side panel. Once the most sensitive range has been adjusted, all higher ranges will accurately read zero as well – provided that the mechanical zero has been adjusted correctly with the display turned OFF.



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## NOTE

**If the 407A is to be used on the 30 mW or 100 mW scales, the detector may be sensitive to temperature fluctuations caused by air currents or air temperature change. Therefore, care should be taken to ensure that the detector is not subject to such fluctuations. If necessary re-zero the readout.**

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## Reading the Meter

The Model 407A features a taut-band style analog meter for the fastest and most sensitive response. An “anticipation” circuit is included which speeds up the natural response time of the detector. The circuit normally provides a small amount of overshoot. If the needle response is too fast or too slow for your needs, the SPEED control may be adjusted. See Chapter 5 for the adjustment procedure.

## Warning on Measuring Pulsed Lasers

Your Model 407A CW head is not designed to monitor pulsed lasers. Even though average output power may be low, the high energy, high peak power pulses from some lasers (Q-switched lasers, for example) can cause irreversible damage to the detector in the Model 407A due to excessive instantaneous local heating of the detector surface. Pulsed laser power is best measured using a detector designed for that application.

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## NOTE

**Replacement of the detectors which have been damaged by pulsed laser beams is not covered under warranty.**

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Use the following peak power density specifications to help you decide if the Model 407A is suitable to use in your application.

Specification	Model 407A
Max Peak Energy Density (50 nsec pulse)	0.3 J/cm <sup>2</sup>

The Model 407A is NOT recommended for use with low repetition rate, high energy pulsed lasers. Consult Newport about your particular application **before** monitoring pulsed lasers.

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## Limitations on Use of Thermal Detectors

Thermal Detectors convert light into heat which in turn generates a change in temperature. In case of thermopiles the change in temperature is relative to a second set of junctions held at a reference temperature. This is significant for two reasons. First, if the reference temperature itself changes then the output signal may contain a spurious component. For instance, if the detector is subjected to high incident power for a prolonged period the entire head – including the reference junctions—will warm up. If the detector then is subjected to a weak incident beam, the power reading may drift as the reference junction adjusts to a cooler equilibrium state. This effect is temporary and may only be noticeable with power changes of 1 to 2 orders of magnitude.

The second limitation to thermal detectors is that they respond to any heat source – not only lasers. This effect can be noticed on the most sensitive (30mW, 100mW) scales. Noise in the form of drift or slow random motion can be caused by simply grasping the cooling fins with a hand or by blowing on the detector (not recommended). A more serious nuisance is drafts with the lowest scale take care to shield the detector head from large drafts.

**Introduction**

Your Model 407A is calibrated at the factory with 1 watt of laser power at 810 nm. If re-calibration is ever required, the procedures given in this chapter allow you to work on your own. Power is generally applied to the detector in form of laser radiation. Sensitivity is adjusted with CALIB control and meter response rate is set with SPEED control. Both controls are accessible through the rear cover of the display unit.

**Equipment Required**

- Laser operating at desired wavelength and power (good intensity stability makes the job easier)
- Laser goggles (as required)
- Reference standard power meter calibrated at desired wavelength and power
- Screwdriver with 1/8" (3mm) wide blade
- External laser beam block (for setting SPEED control)

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**CAUTION**

**Watch out for stray reflections!!**

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**NOTE**

**Absorptance by the detector's surface is a function of the laser wavelength being measured (see Figure 1-1). This variation in absorptance must be taken into account when making exacting power measurements at wavelengths other than that at which calibration is preformed.**

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## Procedure

1. Set up the laser to operate at the desired wavelength and power. Verify power with a calibrated reference standard power meter.
2. Set up your Model 407A so that the meter is easily readable and you have easy access to the CALIB and SPEED controls in the back of the display unit. A mirror can be used to view the meter while adjusting the controls. The meter has a mirrored scale to prevent parallax error during reading.
3. Check the mechanical zero of the 407A's meter while the unit is OFF.
4. Rotate the 407A's rotary switch to the 1 W setting (1 W calibration is assumed in this procedure).
5. Align the 407A's meter pointer with "0" on the upper scale by adjusting the ZERO control.
6. To adjust the meter, place the detector head in the path of the laser beam and allow the meter reading to stabilize. Adjust the CALIB control to give full upper scale deflection of the meter pointer (i.e., pointer aligned with "10"). The CALIB control is accessible through the rear panel of the display unit with a 1/8" (3mm) wide blade screwdriver. Clockwise rotation of the control (when viewed from rear cover) increases the meter reading.
7. Block the laser beam and let the meter pointer return to "0". Due to cooling of the head you may have to wait a minute to allow the meter reading to settle to its final value. Adjust the ZERO control if necessary.
8. Remove the beam block once again and verify the meter reading for laser power.
9. Recheck the meter zero (block the beam).
10. Meter response rate can be varied by adjusting the SPEED control. This control is accessible through the rear cover to the display unit. For heads and displays sold together as matched serial numbers, the SPEED control is adjusted at the factory to give 1 to 2 percent overshoot in the meter's response.

This amount of overshoot allows reasonable meter response rate with minimum settling time and provides acceptable noise performance at low power settings.

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The SPEED control can be adjusted as follows:

- a. Set the laser power to give meter pointer deflection of approximately 90 percent full scale (upper scale).
- b. Block the laser beam and let the meter reading return to zero.
- c. Unblock the beam and note the meter response. Overshoot can be measured by counting the small divisions on the upper scale between the maximum pointer excursion and the final resting position. Each small division on the upper scale corresponds to 2 percent of the full scale. For example, 2 divisions of overshoot corresponds to 4 percent overshoot.
- d. Adjust the SPEED control to give the desired meter response rate. Clockwise rotation of the control (when viewed from the rear cover) gives faster meter response to change in detector heating.

11. Check laser power again with the reference standard meter.

**Introduction**

Your Model 407A requires no routine maintenance. Newport does not recommend user repair of this product. If your unit needs repair, we recommend that you return it to the nearest Newport Service Center.

However, we recognize that there may be times when return of the unit to a repair facility might pose a hardship or inconvenience. For this reason, we provide the following technical description for changing the meter lamps and the rechargeable battery (these components are expected to have at least 5 to 10 year service life). No other components should ever require replacement in normal operation.

Note that if the detector disk becomes damaged, the power meter read-out and head should be returned together to your local Newport Service Center.

**Replacement Items**

The 5 foot (1.5 m) connecting cable between detector head and the display unit has male BNC terminations and uses RG174/U cable. Newport part number: 6015-0290.

Two types of battery chargers are sold with the Model 407A:

Voltage	Line Frequency	Spectra Physics Part Number
90-132 Vac	50/60 Hz	90036748
198-264 Vac	50 Hz	4004-0602

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## Cleaning Your Unit

Should your power meter display unit need cleaning, please observe the following precautions:

- Clean the meter face with a mild detergent and a moist (not wet) SOFT CLOTH to avoid scratching the plastic face; do not use solvents.
- Do not allow solvents to come in contact with the plastic knobs.
- Do not attempt to clean the surface of the detector in the head.

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### CAUTION

**Only experienced service professional should attempt the following procedures. For field replacement of the meter lamps or battery, refer the work to a qualified service professional, experienced in repairing instruments of this type.**

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## Opening the Display Unit

Should you need to replace the meter lamp or the battery, use the following procedure to open the unit and access the circuit board. Take care not to scratch the plastic meter face.

### Tools Required

- 1/4" nut driver (3/8"OD socket), or a wide blade screwdriver
- #1 Phillips screwdriver
- 1/16" hex driver
- 5/64 hex driver

### Procedure

1. Set the rotary switch to the OFF position.
2. Pry the cap from the ZERP knob and use the 1/4" nut driver or a flat blade screwdriver to loosen the collet nut. Remove the ZERO knob.
3. Remove the screws from the back cover. Corner screws are 3 mm Phillips head while those in the central area are #4-40 Button head or Torx head, depending on the model and serial number.

- 
4. Remove the black flat head screw (36-32) and washer from the bail on that side of the unit in which the BNC receptacles and the charger jack are located.
  5. CAREFULLY tip the housing over just enough to allow one end of the circuit board to swing out of the housing. Grasp the circuit board by its edges and continue to swing the board until the rotary knob clears the housing. Avoid touching the circuitry on the board so as not to contaminate it with finger oils. Now, slowly pull the board out of the housing, being careful not to break the wire leads which connect the circuit board to the panel meter. The metal nut bracket will fall loose at this time. **WATCH THAT YOU DO NOT DISTURB THE SETTINGS OF THE POTENTIOMETERS LOCATED ON THE SOLDER SIDE OF THE BOARD.**
  6. Taking care not to damage the meter face, set the housing to one side and position the board so that it rests on its standoffs on a smooth non-conductive surface.

Should the wire leads between the circuit board and the meter break, you may carefully solder them back in place. If you need to solder one of the meter terminals, clamp the terminal with a hemostat below the point at which you want to solder. The hemostat will act as a heat sink and prevent softening of the meter case at the entry point of the terminal. On the circuit board end, the red wire is connected at the hole marked "M2+" and the black wire is connected at the hole marked "M1-". Do not apply excessive heat to the circuit board as this may cause lifting of the pads and traces.

## **Reassembling the Display Unit**

1. Make sure that the rotary switch on the circuit board is in the OFF position (fully counterclockwise).
2. Pick up the circuit board by its edges and orient it so that the component side faces the inside of the housing. **WATCH THAT YOU DO NOT DISTURB THE SETTINGS OF THE POTENTIOMETERS LOCATED ON THE SOLDER SIDE OF THE BOARD.** Take care not to break the wire leads which connect the circuit board to the panel meter.



- 
3. Fit the metal nut bracket over the end of the board which contains the BNC receptacles and the charger jack; the bracket's tab rests in the shallow cutout at that end of the board. Make sure that the piece of Kapton insulating tape is still on the underside of the bracket, facing the solder side of the board.
  4. Keeping a finger on the nut bracket, slide the circuit board down into the housing at an angle. Insert the BNC receptacles and the charger jack into the holes provided in the wall of the housing. Continue to push the board until it stops against the wall of the housing. At this point, check to see that the meter lights will slide down between the panel meter and the housing. Also make sure that the BATT LOW LED is straight in its socket. The rest of the board now should be free to fall into place in the housing. While swinging the board into place, make sure that the BATT LOW LED fits into the hole provided for it in the front surface of the housing.

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#### NOTE

**If for some reason, the LED is removed from its socket, it needs to be reinstalled, the flat index mark on the LED should face AWAY from the rotary switch.**

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5. On the outside of the housing above the charger jack, insert the black plastic washer between the bail and the housing. Then insert the black flat head screw enough to engage it in the threads of the nut but do not tighten it yet.
6. Replace the back cover and loosely install the 4 button head screws through the central holes and into the threaded standoffs of the circuit board inside.
7. Reinstall the ZERO control knob on the shaft letting 7/16" (11mm) of the knob's end protrude from the outside wall of the housing. Replace the knob cap at this time.
8. Position the circuit board using the BNC receptacles and the ZERO knob so that the ZERO and the rotary switch knobs are able to rotate freely in their holes. Then tighten the 4 button head screws.

- 
9. At the end of the housing which contains the metal nut bracket, install 2 of the 3 mm Phillips head screws at the corners of the back cover, engaging the nuts in the bracket inside. Tighten the screws evenly in order to keep the bracket inside as level as possible.
  10. Install the remaining 3mm Phillips head screws in the corners of the cover.
  11. Tighten the black flat head screw which retains the bail.

## **Replacing Meter Lamps**

The meter is illuminated by two lamps when the charger is plugged in. To change lamps, follow the procedures given above for removing the circuit board from its housing. Then unplug the lamps from their socket and replace with new ones. We recommend that you replace both lamps at the same time. Reassemble the unit using the procedure above.

The meter lamps are General Electric equivalent #8099 Newport part number: 3901-2040.

## **Replacing the Battery**

When the battery no longer holds a charge, or when the BAT LOW LED blinks continually even with the charger plugged in, the battery should be replaced.

Not all "9 volt" Nickel-Cadmium rechargeable batteries are equivalent. Battery voltages of 8.4 and 7.2 volts are common. Due to differing internal cell construction, battery capacity and durability may vary between battery types. The battery recommended by Newport is not damaged when the charger is left plugged into the display unit for long periods of time.

Newport recommends the following replacement battery for the Model 407A:

Varta #V7/8R 8.4 volts, 100mAh  
Newport part number: 4006-0290

In replacing the battery, follow the procedure given above for removing the circuit board from its housing and for reassembling the unit.

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## WARNINGS

**DO NOT incinerate or mutilate batteries;  
they will burst or release toxic materials.**  
**DO NOT short circuit batteries; this may cause burns.**  
**Old and new batteries may be partially charged.**  
**Be cautious during battery replacement and disposal.**

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## WARNING

**Do not attempt to use a NiMH battery in your Model 407A Instrument. The charging circuitry only supports NiCd chemistry batteries and there is a severe risk of explosion or fire if a NiMH-Chemistry battery is substituted**

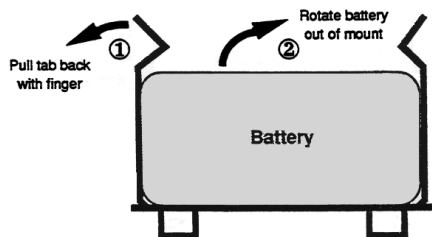
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## CAUTION

**The use of shatterproof protective eyewear is recommended  
for the following steps**

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*Figure 6-1*

1. Make sure that the rotary switch is in the OFF position (most counterclockwise). Unplug the battery from its mounting bracket terminals. The circuit board has a hole drilled in it between the battery terminals. A suitable stiff insulated rod may be inserted through the mounting bracket and anchored in the hole. Then the rod can be pulled back as a lever to separate the battery from the bracket's terminals. A 3/32" flat blade screwdriver, with 3" long blade insulated with a piece of shrink tubing works well as a rod.

2. Remove the battery from the mounting bracket's clip as shown in Figure 6-1. Use a thumb or forefinger of one hand to pull back one side of the clip and use the fingers of the other hand to rotate the battery and pull it out of the clip. The clip is rather stiff so be careful no to hurt your fingers or fingernails. Be careful not to break the wire connections from the circuit board to the panel meter. Avoid touching the circuitry on the board so as to not contaminate it with finger oils.
3. Cover the terminals of the old battery with nonconductive tape (such as the vinyl tape used by electricians) and dispose of the battery following local ordinances.
4. Use a similar procedure as in Step 2 to install the new battery in the mounting brackets clip. Use caution since the battery may be charged.
5. Reconnect the battery to the bracket's terminals. Use one hand to grasp the circuit board by the edges. Use the index and the middle fingers of the other hand to restrain the battery mount's terminals while pushing on the end of the battery with the thumb of that same hand.
6. Reinstall the circuit board following the procedure given in the section at the beginning of this chapter.

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**WARNING – Battery Disposal**  
**DO NOT PLACE USED BATTERIES INTO THE**  
**NORMAL WASTE DISPOSAL STREAM.**



The Model 407A's battery contains Cadmium, a heavy metal that can have serious environmental impacts if it is placed into the normal waste disposal stream. For this reason, used batteries must be separated from normal trash and recycled.

**Dispose of used batteries in accordance with local waste regulations. Within the European Union and other jurisdictions with mandated "Take Back" regulations, contact your local Newport sales office or representative for information on where to send used batteries for proper disposal and recycling.**

**Introduction**

To obtain information regarding factory service, contact Newport Corporation's Service Department or your Newport representative. Please have the following information available:

- Instrument model number (on the rear panel)
- Instrument serial number (on rear panel)
- Description of the problem
- Your contact information

To help our Technical Support Representatives diagnose your problem, please note the following conditions:

- Is the system used for manufacturing or research and development?
- What was the state of the system right before the problem?
- Have you seen this problem before? If so, how often?
- Can the system continue to operate with this problem? Or is the system non-operational?
- Can you identify anything that was different than before this problem occurred?

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## Technical Support Contacts

### North America & Asia

Newport Corporation Service Dept.  
1791 Deere Ave. Irvine, CA 92606  
Telephone: (949) 253-1694  
Telephone: (800) 222-6440

### Europe

Newport/MICRO-CONTROLE S.A.  
Zone Industrielle  
45340 Beauce la Rolande, FRANCE  
Telephone: (33) 02 38 40 51 56

### Asia

253 Aidu Road, Bld #3, Flr 3, Sec C  
Shanghai 200131, China  
Telephone: +86-21-5046 2300  
Fax: +86-21-5046 2323

## Newport Corporation Calling Procedure

If there are any defects in material or workmanship or a failure to meet specifications, promptly notify Newport's Returns Department by calling

1-800-222-6440 or by visiting our website at [www.newport.com/returns](http://www.newport.com/returns) within the warranty period to obtain a Return Material Authorization Number (RMA#). Return the product to Newport Corporation, freight prepaid, clearly marked with the RMA# and we will either repair or replace it at our discretion. Newport is not responsible for damage occurring in transit and is not obligated to accept products returned without an RMA#.

### E-mail: [rma.service@newport.com](mailto:rma.service@newport.com)

When calling Newport Corporation, please provide the customer care representative with the following information:

- Your Contact Information
- Serial number or original order number
- Description of problem (i.e., hardware or software)

To help our Technical Support Representatives diagnose your problem, please note the following conditions:

- Is the system used for manufacturing or research and development?
- What was the state of the system right before the problem?
- Have you seen this problem before? If so, how often?
- Can the system continue to operate with this problem?  
Or is the system non-operational?
- Can you identify anything that was different before this problem occurred?



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Newport Corporation, Irvine, California, has been certified compliant with ISO 9001  
by the British Standards Institution.